Skid Resistance of a Road Pavement using a SCRIM® Machine

Test Method
RC 421.02
March 2018

1 SCOPE

This test method details the measurement of the skid resistance of a road pavement surface using a Sideways-force Coefficient Routine Investigation Machine (SCRIM®).

Note : SCRIM® is a registered trademark of W.D.M. Limited

2 DEFINITIONS

2.1 SCRIM® (Sideways-force Coefficient Routine Investigation Machine) – a self-contained machine for the measurement of skid resistance under wet road conditions. It is capable of maintaining a constant test speed and measuring both wheel paths independently**.**

2.2 SCRIM® Reading (SR) **–** the ratio of the sideways forces to the vertical reaction on the test wheel recorded as an individual measurement for a single sub-section of pavement surface 5 meters long. It is expressed as a positive, unsigned integer, unadjusted for speed or temperature.

2.3 SCRIM® Coefficient (*SC*) – a SCRIM® reading adjusted after any relevant corrections for load, speed, and temperature.

2.4 Sideways Force Coefficient (SFC_m) – the SCRIM® coefficient identified with a subscript designating the test speed (m) is shown, e.g. SFC_{50}.

2.5 Differential Friction Level (*DFL*) – the difference between the SCRIM® Coefficient value obtained for each wheel path at the same chainage.

2.6 Section Sideways Force Coefficient ($SSFC_m$) – the calculated minimum section skid resistance levels for each wheel path over 100 m in length.

2.7 Investigatory Level – level of skid resistance at or below which and/or the different frictional level above which a site investigation is to be undertaken (see Table 2).

2.8 Section – A 100 m length of road pavement surface.

3 APPARATUS

The following apparatus is required:

(a) A SCRIM® machine capable of travelling at constant speeds of 20 km/hr and 50 km/hr and fitted with:

(i) a water tank which is capable of discharging water onto road surface immediately in front of the test wheel at a rate of 60 L/min during the test;

(ii) two freely rotating test wheels with axis centred in the normal traffic wheel paths and the distance between the line of loading of the wheels known to within ± 0.1 m. The wheels shall be fitted with standard test tyres (3.00 x 20, manufactured by the Avon Tyre Company, England) operated at a tyre pressure of 350 ± 20 kPa (when tested cool), inclined 20 ± 0.5°(toe-in angle) to the direction of travel to which a vertical load of 2 kN ± 10 N is applied;

(iii) a load cell attached to each wheel to measure the sideways force shall be capable of measuring loads of up to 3 kN to the nearest ± 0.5 N;

(iv) a device for measuring speed of travel of the vehicle to within ± 1 km/hr;

(v) a device for measuring the distance travelled to within ± 1 m/km;

(vi) a data acquisition system which is capable of capturing SCRIM® readings, forward speed, ambient temperature and distance measurements every 5 m of travel.

(b) Water free from foam, oil scum and other materials which may affect the measurement.

(c) A device for measuring the tyre pressure to within ± 10 kPa.

(d) Temperature measuring device capable of measuring ambient temperature to within ± 1°C.

(e) Load cells and displays for use in checking the vertical load and for the static calibration of the sideways force on the test wheel.

4 PROCEDURE

4.1 Daily checks

(a) Prior to commencement of operations on each day, check that the tyre pressure in the standard test tyres when cold is 350 ± 20 kPa. Check the tyres for damage and wear.

Note: A test tyre shall be discarded when the loss in diameter of the tyre exceeds 12 mm or when otherwise damaged.

(b) Check that there is sufficient water in the tank to provide water to the surface for each test run.

(c) After warming up the SCRIM® measuring and data acquisition systems or immediately after completion of a day's testing, check the sideways loads on the wheel by comparing the digital readout from the data acquisition system and the load as measured by the load cell, for each wheel. If any variation to the output reading is required, record this adjustment as C_a.

(d) When new tyres are placed on the measuring wheels the tyres shall be conditioned by running them as detailed in the measurement procedure for 1 km.

4.2 Measurement

(a) Turn on the water to ensure that water is flowing under the test tyre, lower the test wheel and apply the 2 kN load.

(b) Operate the SCRIM® machine to travel at a notional speed nominated in Table 2 dependent on the Site Category. The test tyres shall be located in the wheel paths required for test. Due to variations in traffic conditions, it is permissible to operate at speeds shown in Table 1 provided the corrections shown are applied to the readings. Corrections outside 16-24 km/hr are not permitted when testing Site Category 6 or 7. When speeds fall outside the limits shown, the results should be flagged as unsuitable for analysis.

Table 1: Speed Correction to SCRIM® readings

Speed (km/hr) (Site Categories 1 to 5)	Speed Correction (S_c) to SCRIM® Reading
67-65	+3
64-60	+2
59-55	+1
54-46	0
45-42	-1
41-38	-2
37-34	-3
33-30	-4

(c) Set the data acquisition system to obtain the following readings for each test wheel every 5 m:

(i) SR (SCRIM® Reading) (see definitions and calculations)
(ii) Odometer reading
(iii) Test speed
(iv) Ambient temperature
(v) At each test site, record the site category related to the site description detailed in Table 2. As necessary during each test run, record any change in road surface conditions and features.

(d) For each section or run, record:

(i) date
(ii) surface type
(iii) lane tested
(iv) start and end distances of run and reference points.

5 CALCULATIONS

5.1 At each test site

Calculate:

(a) SCRIM® Reading *(SR)* using the following equation:

$$SR = \frac{Sideway\ Reaction}{Vertical\ Reaction} \times 100$$

where;

Sideway reaction = horizontal force measured on the wheel, in N

Vertical reaction = vertical load on the surface (2 kN ± 10 N)

(b) The SCRIM® Coefficient *(SC)* after correction for load, speed and temperature from the following equation:

$$SC = [SR + C_a + S_c + 0.3(T - 20)]/100$$

where;

SC = SCRIM Coefficient (index)

SR = SCRIM® readings

C_a = adjustment to output readings determined in Step 4.1 (c).

S_c = speed correction for actual speed determined from Table 1

T = ambient temperature, in ^{0}C

(c) Sideways Force Coefficient specifying the speed using the following equation:

$$SFC_m = SC$$

where;

SFC_m = Sideway force coefficient for test speed of *m* km/hr to which readings were adjusted in Step (c).

(d) The differential friction level (*DFL*), for each chainage.

5.2 When required, for each 100m section:

(a) Calculate the mean of a four-point rolling average on all data (left and right wheel paths separately) by replacing the value for a point (site) by the mean value of that point, the two previous points and the next point.

(b) Calculate the Section Sideways Force Coefficient *($SSFC_m$)* by determining the minimum value of all data points for both wheel paths (40 points) of the values determined in Step 5.1(c).

(c) Determine the section differential friction level by identifying the average difference between adjoining adjusted SFC_m reading pairs over the 100 m section.

6 TEST REPORT

Report the following:

6.1 For each site

(a) The sideways force coefficient (SFC_m) to the nearest 0.01.

(b) The site location.

6.2 For each test run

(a) Date.

(b) Surface type.

(c) Lane(s) tested.

(d) Start and end distances of run and reference points.

6.3 When required, for each section

(a) The Section Sideway Force Coefficient *(*$SSFC_m$*)* to the nearest 0.01.

(b) The maximum differential friction level to the nearest 0.01.

(c) The minimum four-point average for SFC_m for each wheel path.

(d) The investigatory level for skid resistance and maximum differential friction levels as determined from Table 2.

Note : Refer VicRoads Technical Note TN 110 for more information about reporting of surface skid resistance data.

7 Reference

VicRoads Technical Note TN110 – *Measurement and Interpretation of Skid Resistance using a SCRIM® Machine*.

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VicRoads Test Method - Revision Summary

RC 421.02 – Skid Resistance of a Road Pavement using the SCRIM® Machine

Date	Clause	Description of Revision	Authorised by
March 2018	Title 1, 2.1, 2.2, 2.3, 2.4, 2.5 3(a), 3(a)(vi) (4.1((c), 4.2(b), 4.2(c)(i) Table1, Table 2 5(a), 5(b)	Revised to reflect SCRIM® is a registered trade mark of W.D.M. Limited	Manager – Construction Materials
	5.1 (b)	All relevant correction for SC compiled into one equation	
	4.2(d), 6.2	Exclude non-recording parameters in the testing process	
	Table 2	Revised table topic to match with the definition in Section 2.7	
	4.2(a)	Corrected vertical load as 2kN	
	5.2(b)	Revised content to match with the definition in Section 2.6	
	2.4, 5.1(c), 6(a), Table 2	Changed sfc_m as SFC_m to maintain consistency with relevant technical documents	
	2.6, 5.2(b), 6.3(a)	Changed $Ssfc_m$ as $SSFC_m$ to maintain consistency with relevant technical documents	
	2.5	Changed DFL definition according to the SC calculation	
	7	Included reference	
	Table 2	Added separate investigatory levels for SFC_{50} and SFC_{20} as reported and typical international practice Defined lower limit (>100m) of the tight curves Revised and added notes	

Table 2: Investigatory Level for Skid Resistance

Site Category	Site Description	Investigatory Levels of SFC_{50} (At 50 km/hr or equivalent – as reported)						
		30	35	40	45	50	55	60
		Investigatory Levels of SFC_{50} (At 50 km/hr or equivalent – typical international practice)						
		0.30	0.35	0.40	0.45	0.50	0.55	0.60
1 #	• Signalised intersections • Pedestrian/school crossings • Railway level crossings • Roundabout approaches	INVESTIGATION ADVISED					■	
2	• Curves with radius ≤ 250 m and > 100m • Gradient ≥ 5% and ≥ 50 m long Freeway/highway on/off ramps					■		
3 #	• Intersections				■			
4	• Manoeuvre-free areas of undivided road			■				
5	• Manoeuvre-free areas of divided roads		■					

Site Category	Site Description	Investigatory Levels of SFC_{20} (At 20 km/hr or equivalent -as reported)						
		30	35	40	45	50	55	60
		Investigatory Levels of SFC_{50} (At 50 km/hr or equivalent – typical international practice)						
		0.30	0.35	0.40	0.45	0.50	0.55	0.60
6	• Curves with radius ≤ 100 m	INVESTIGATION ADVISED						■
7 #	• Roundabouts						■	

Key to Thresholds at or below which Investigation is Advised

■ Roads with more than 2,500 vehicles per lane per day

■ Roads with less than 2,500 vehicles per lane per day

Notes:

(a) **#** - indicates investigatory level for Site Categories 1, 3 and 7 are based on the minimum of the four-point rolling average skid resistance from 50 m before to 20 m past the feature, or for 50 m approaching a roundabout.

(b) Investigatory levels for Site Categories 2,4, 5 and 6 are based on the minimum of the four-point rolling average skid resistance for each 100 m length.

(c) The difference in Sideways Force Coefficient values between wheel paths (Differential Friction Levels) should be less than 0.10 (or 10 as reported) where the speed limit is greater than 60 km/hr; or less than 0.20 (or 20 as reported) where the speed limit is 60 km/hr or less.

(d) Curves with radius> 250 m and gradient < 5 % are to be considered as either Site Category 4 or 5.